98-G-304, Neutrinos at the Main Injector (NuMI), Fermi National Accelerator Laboratory, Batavia, Illinois

(Changes from FY 2002 Congressional Budget Request are denoted with a vertical line [|] in the left margin.)

Significant Changes

The Total Project Cost (TPC) has been adjusted due to an increase in the Total Estimated Cost (TEC). This adjustment was made as a result of the recent Cost, Scope and Schedule Rebaselining review that took place in September 2001, as well as a staff review of the results of the Rebaselining review. The increase in the TEC/TPC has been approved by the Department of Energy.

There are several causes for the TEC change. Due to a tight market for civil construction, the cost for excavating tunnels and halls at the Fermi National Accelerator Laboratory (Fermilab) is considerably higher than the initial estimate. Rebidding this subcontract to reduce its cost entailed a significant delay, as has the subsequent performance of the work. Treatment and disposal of tunnel discharge water has also increased the cost. Experience has demonstrated that inadequate engineering resources were initially applied to the project. Thus, the cost of beam-line components was underestimated. The difficulty of constructing an underground facility to safely accommodate the extremely high intensity proton beam needed to produce an adequate number of neutrinos was also underestimated. The shielding required to suppress the secondary radioactivity has turned out to be significantly more extensive than originally planned, and the radiation levels near the target station will require a significant remote handling capability for routine operation and maintenance. The beam-line technical components costs now reflect results of a prototyping program along with more refined engineering estimates; labor is a substantial part of the increase. Also, the overall contingency on the TEC has been adjusted to reflect these changes. Both the Department of Energy and Fermilab have strengthened their management to execute the project within the new baseline.

The MINOS detector for NuMI, funded as part of the Other Project Costs, is proceeding well, and the contingency and the projected total cost for the detector have been reduced accordingly. Completion is expected within the revised project cost and schedule.

The funding schedule for the project now extends through FY 2005, with operation of the NuMI facility starting in FY 2005.

1. Construction Schedule History

	Fiscal Quarter				Total Estimated Cost ($000)	Total Project Cost ($000)
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
FY 1998 Budget Request *(A-E and technical design only)*	1Q '98	4Q '98	NA	NA	5,500	6,300
FY 1999 Budget Request (Preliminary Estimate)	--	3Q '99	1Q '99	4Q '02	75,800	135,300
FY 2000 Budget Request	3Q '98	2Q '00	3Q '99	2Q '03	76,200	136,100
FY 2001 Budget Request	3Q '98	2Q '00	3Q '99	2Q '04	76,200	138,600
FY 2001 Budget Request (Amended)	3Q '98	2Q '00	3Q '99	4Q '03	76,200	138,400
FY 2002 Budget Request	3Q '98	4Q '00	3Q '99	4Q '03	76,149	139,390
FY 2003 Budget Request	3Q '98	4Q '00	3Q '99	4Q '05	109,242	171,442

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
Design & Construction			
1998	5,500	5,500	1,140
1999	14,300	14,300	5,846
2000	22,000	22,000	15,089
2001	22,949	22,949	19,752
2002	11,400	11,400	30,000
2003	20,093	20,093	20,000
2004	12,500	12,500	14,000
2005	500	500	3,415

3. Project Description, Justification and Scope

The project provides for the design, engineering and construction of new experimental facilities at Fermi National Accelerator Laboratory in Batavia, Illinois and at the Soudan Underground Laboratory at Soudan, Minnesota. The project is called NuMI which stands for Neutrinos at the Main Injector. The purpose of the project is to provide facilities that will be used by particle physicists to study the properties of neutrinos, which are fundamental elementary particles. In the Standard Model of elementary particle physics there are three types of neutrinos that are postulated to be massless and to date, no direct experimental observation of neutrino mass has been made. However, there are compelling hints from experiments that study neutrinos produced in the sun and in the earth's atmosphere that indicate that if neutrinos were capable of changing their type it could provide a credible explanation for observed neutrino deficits in these experiments.

The primary element of the project is a high flux beam of neutrinos in the energy range of 1 to 40 GeV. The technical components required to produce such a beam will be located on the southwest side of the

Fermilab site, tangent to the new Main Injector accelerator at the MI-60 extraction region. The beam components will be installed in a tunnel of approximately 1.5 km in length and 6.5 m diameter. The beam is aimed at two detectors (MINOS), which will be constructed in experimental halls located along the trajectory of the neutrino beam. One such detector will be located on the Fermilab site, while a second will be located in the Soudan Underground Laboratory. Two similar detectors in the same neutrino beam and separated by a large distance are an essential feature of the experimental plan.

The experiments that are being designed to use these facilities will be able to search for neutrino oscillations occurring in an accelerator produced neutrino beam and hence determine if neutrinos do have mass. Fermilab is the only operational high energy physics facility in the U.S. with sufficiently high energy to produce neutrinos which have enough energy to produce tau leptons. This gives Fermilab the unique opportunity to search for neutrino oscillations occurring between the muon and the tau neutrino. Additionally, the NuMI facility is designed to accommodate future enhancements to the physics program that could push the search for neutrino mass well beyond the initial goals established for this project.

4. Details of Cost Estimate [a]

(dollars in thousands)

	Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design costs	7,150	7,150
Design Management costs (0.0% of TEC)	10	10
Project Management costs (0.0% of TEC)	20	20
Total, Engineering design inspection and administration of construction costs (6.6% of TEC)	7,180	7,180
Construction Phase		
Buildings	12,228	8,320
Special Equipment	20,902	10,120
Other Structures	41,265	30,960
Construction Management (6.3% of TEC)	6,846	4,590
Project Management (4.4% of TEC)	4,788	2,170
Total, Construction Costs	86,029	56,160
Contingencies		
Design Phase (0.0% of TEC)	0	2,172
Construction Phase (14.7% of TEC)	16,033	10,637
Total, Contingencies (14.7% of TEC)	16,033	12,809
Total, Line Item Cost (TEC)	109,242	76,149

[a] The annual escalation rates assumed for FY 1999 through FY 2005 are 2.4, 2.8, 2.7, 3.0, 3.1, 3.4, and 3.3 percent respectively.

5. Method of Performance

Design of the facilities will be by the operating contractor and subcontractor as appropriate. To the extent feasible, construction and procurement will be accomplished by fixed-price contracts awarded on the basis of competitive bids.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 2001	FY 2002	FY 2003	Outyears	Total
Project Cost						
Facility Cost						
Total, Line item TEC	22,075	19,752	30,000	20,000	17,415	109,242
Other Project Costs						
Capital equipment [a]	7,627	9,571	14,681	9,928	2,703	44,510
R&D necessary to complete construction [b]	1,300	0	0	0	0	1,300
Conceptual design cost [c]	830	0	0	0	0	830
Other project-related costs [d]	8,542	3,069	3,725	224	0	15,560
Total, Other Project Costs	18,299	12,640	18,406	10,152	2,703	62,200
Total Project Cost (TPC)	40,374	32,392	48,406	30,152	20,118	171,442

[a] Costs to fabricate the near detector at Fermilab and the far detector at Soudan. Includes systems and structures for both near detector and far detector, active detector elements, electronics, data acquisition, and passive detector material.

[b] This provides for project conceptual design activities, for design and development of new components, and for the fabrication and testing of prototypes. R&D on all elements of the project to optimize performance and minimize costs will continue through early stages of the project. Specifically included are development of active detectors and engineering design of the passive detector material. Both small and large scale prototypes will be fabricated and tested using R&D operating funds.

[c] Includes operating costs for development of conceptual design and scope definition for the NuMI facility. Also includes costs for NEPA documentation, to develop an Environmental Assessment, including field tests and measurements at the proposed construction location.

[d] Includes funding required to complete the construction and outfitting of the Soudan Laboratory for the new far detector by the University of Minnesota.

7. Related Annual Funding Requirements

(FY 2003 dollars in thousands)

	Current Estimate	Previous Estimate
Annual facility operating costs [a]	500	500
Utility costs (estimate based on FY 1997 rate structure) [b]	500	500
Total related annual funding	1,000	1,000
Total operating costs *(operating from FY 2003 through FY 2007)*	5,000	5,000

[a] Including personnel and M&S costs (exclusive of utility costs), for operation, maintenance, and repair of the NuMI facility.

[b] Including incremental power costs for delivering 120 GeV protons to the NuMI facility during Tevatron collider operations, and utility costs for operation of the NuMI facilities, which will begin beyond FY 2002.